WEAR RESISTANT DRIVE ROLLER FOR WIRE FEEDING MECHANISM

Background of the Invention

Field of the Invention

The present invention relates to the art of wire feeding mechanisms and, more particularly, to drive rollers used in wire feeding mechanisms for driveably advancing a welding wire. The present invention finds particular application in conjunction with drive rollers used to advance a relatively welding wire and will be described with particular reference thereto. It is to be appreciated, however, that the present invention may relate to other similar environments and applications.

Discussion of the Art

U.S. Patent No. 6,557,742 to Bobeczko et al., U.S. Patent No. 5,816,466 to Seufer and U.S. Patent No. 4,235,362 to Hubenko, all expressly incorporated herein by reference, disclose wire feeding mechanisms and provide general background information related thereto.

Wire feeding mechanisms that move consumable electrode wire from a supply reel to a welding gun are generally well known. For example, Seufer discloses a wire feed mechanism having a wire pathway through which a continuous length of wire is advanced. Typically, wire feed mechanisms include motor-driven drive rolls that engage diametrically opposite sides of a wire to move the wire along a path through a housing of the feeding mechanism. Once through the housing, the wire is moved through a flexible tube or conduit leading to a welding gun. Often, the conduit also carries shielding gas and electrical current to the welding gun.

Typically, each of the drive rollers is mounted on a roller support and all of the roller supports are driveably engaged with one another. Thus, powered rotation of a single roller support causes rotation of all the roller supports and the

drive rollers supported thereon. Usually, the drive rolls are a single pair of opposed rollers or a double pair of opposed rollers spaced apart along the wire path. In either arrangement, the drive rollers have an upstream side at which the wire enters the drive rollers and a downstream side at which the wire exits the driver rollers. On the upstream side, the wire is guided through an upstream tube toward a bite created between the drive rollers adjacent the upstream side. Likewise, on the downstream side, the wire exits the drive rollers and is guided through a downstream tube adjacent the downstream side. If a double pair of opposed rollers are used, another tube can be provided between the pairs of drive rollers to further guide the wire.

To impart an advancing force or motion to the wire, opposing drive rollers are positioned sufficiently close to one another so that the wire extending along the pathway is compressed between the opposing rollers. The compressive force in combination with friction between the material of the wire and the rollers advances the continuous length of wire along the wire path in a generally smooth and continuous manner. In some arrangements, one or more of the drive rollers are urged toward the wire by a biasing member to further impart an advancing force or motion on the wire.

The wire passing through the drive rollers has a generally round cross-section and is engaged tangentially by opposing drive rollers mounted transversely to the wire. As a result of this arrangement, the compressive forces exerted on the wire by the driver rollers often cause the wire to undesirably deform. The material characteristics of the wire largely determine the magnitude or amount the wire is deformed as a result of the compressive forces. Accordingly, a wire made from a material having a relatively high compressive yield strength, such as steel, will be deformed less than a wire made from a material having a moderate compressive yield strength, such as aluminum.

In some applications, the drive rollers include U-shaped or V-shaped grooves extending circumferentially thereabout for reducing the deformation of the wire from the compressive forces of the drive rollers. When grooves are employed, the wire is engaged by side walls of the drive rollers forming the

grooves. As a result, the compressive forces exerted by each pair of drive rollers act and deform the wire along a substantial portion of the wire's outer surface when U-shaped grooves are used and at four locations when V-shaped grooves are used (two side walls engage the wire on each drive roller) compared to only two locations if no grooves were provided (one circumferential surface of each drive roller would engage the wire). More contact between the drive rollers and the wire results in less deformation. Accordingly, drive rollers having grooves tend to deform the wire to a lesser extent than those without grooves.

Although grooves tend to deform the wire less, grooves can cause other problems including the undesirable build-up of wire residue in the grooves, particularly when aluminum wires are used. Such build-up results in an occasional clean up or removal of the residual wire from the grooves. This is undesirable and any improvement that allows grooves to be used while eliminating or reducing the need to clean out the grooves is considered desirable.

With or without grooves, the surfaces of the drive rollers that contact the wire degrade or wear over extended use. Degradation of the drive roller surfaces results in poor contact between the drive rollers and the wire which can cause slippage between the drive rollers and wire as well as other related problems. It is often costly and time consuming to replace or refurbish the drive rollers on wire feed mechanisms so any improvements to the drive rollers that allow the drive rollers to be used for longer periods without replacement or refurbishment are considered desirable.

One known improvement to drive rollers having grooves is to provide a plurality of grooves on each drive roller. This allows each groove to be used sequentially before the drive roller has to be replaced or refurbished. For example, on a drive roller having two grooves, the first groove can be used until it has sufficiently degraded. Then, the wire can be moved to the second groove and it can be used until degradation. Only after both grooves are worn out does the drive roller need to be replaced or refurbished. Despite this improvement, there is still a need to increase the wear resistance of drive rollers and, thus, any

additional improvements that further extend the useful life of drive rollers on wire feed mechanisms are deemed desirable.

Summary of the Invention

The present invention provides new and improved drive rollers for use in wire feed mechanisms that overcome the foregoing difficulties and others and provide the aforementioned and other advantageous features. More particularly, in accordance with one aspect of the present invention, a drive roller is provided for use on a wire feeding mechanism. In accordance with this aspect of the invention, the drive roller includes a hub having an axis and an outer surface extending circumferentially about the axis. A plating is on the outer surface of the hub and extends circumferentially thereabout.

In accordance with another aspect of the present invention, a drive roller for use on a wire feed mechanism is provided to advance a continuous length of wire. More particularly, in accordance with this aspect of the invention, the drive roller includes a hub having an axis and an outer surface extending circumferentially about the axis. A plating is on the outer surface extending circumferentially thereabout and tangentially and compressively contacting an associated continuous length of wire.

In accordance with yet another aspect of the present invention, a wire feeding mechanism is provided for advancing a continuos length of wire along a pathway. More particularly, the wire feeding mechanism includes a housing having two roller supports each rotatable about a corresponding axis transverse to the pathway. The roller supports are on opposite sides of the pathway and are driveably engaged with each other. A drive roller is on each roller support for rotation therewith and has a roller axis coaxial with the axis of the corresponding roller support. The driver roller includes a hub having an outer surface extending circumferentially about the roller axis and one of a plating and a coating on the outer surface. The one of a plating and a coating of each of the drive rollers tangentially and compressively contacts a continuous length of wire

therebetween such that the wire is advanced along the pathway in response to the rotation of the drive rollers.

In accordance with still another aspect of the present invention, a method of imparting wear-resistance to a drive roller is provided for use on a wire feeding mechanism to advance a continuous length of wire. More particularly, in accordance with this aspect of the invention, a drive roller is provided having a hub with an axis and an outer surface extending circumferentially about the axis. The outer surface is liquid honed to prepare the outer surface for a chrome alloy plating. The drive roller outer surface is electrolyzed to apply the chrome alloy thereto.

Brief Description of the Drawings

The invention may take form in various components and arrangements of components and in various steps and arrangements of steps. The drawings are only for purposes of illustrating preferred embodiments and are not to be construed as limiting the invention.

Figure 1 is a schematic view of a wire feeding mechanism having drive rollers in accordance with a preferred embodiment of the present invention; and

Figure 2 is an elevational view of one of the drive rollers of Figure 1 with a portion of the drive roller shown in cross-section.

Figure 3 is an elevational view of a drive roller having a radial groove in accordance with an alternate embodiment of the present invention.

Detailed Description of the Preferred Embodiment

Referring now to the drawings wherein the drawings are for purposes of illustrating a preferred embodiment of the invention only and not for purposes of limiting the same, Figure 1 shows a wire feeding mechanism 10 having a wire pathway 12 defined in part by wire support guides 14,16. The wire feeding mechanism 10 is generally situated between a bulk supply of wire 18 and a workpiece 20. The wire 18 extends from the bulk supply, shown as roll 22 in Figure 1, to the wire feeding mechanism 10, and further extends to the workpiece

20 where it is consumed in the process of welding. The wire 18 can be alternatively supplied in a wide variety of other bulk forms, including for example boxes, reels and the like.

Generally, a flexible conduit 24 extends from the mechanism 10 on a downstream side 26 thereof such that the wire 18 will be advanced by the mechanism 10 through the conduit 24 to a welding gun 28 adjacent the workpiece 20. As the mechanism 10 axially advances the wire 18 along the pathway 12, the advancing wire is radially supported and guided by the flexible conduit 24 toward the workpiece 18 until the wire 16 reaches the gun 28 and is consumed during the welding process. As is known, the conduit 24 can optionally carry shielding gas and electrical current to the welding gun 28. Alternatively, the flexible conduit 24 can be replaced with a rigid conduit terminating at a welding head. In any arrangement, it is to be appreciated that both conduit and welding guns are commonly known and therefore need not be described in further detail herein.

The wire feeding mechanism 10 includes a housing 30 through which the wire pathway 12 is defined. More particularly, the tubular wire support guides 14,16 are spaced along the wire pathway 12 and are oriented such that passages therethrough are axially aligned along and partially define the pathway 12. The wire feeding mechanism 10 further includes a first set of drive rollers 36,38 and a second set of drive rollers 40,42 disposed along the pathway 12 in spaced relation relative to one another. The drive rollers 36-42 function to advance the continuous length of wire 18 as will be described in more detail below. More particularly, one drive roller from each pair of drive rollers, drive roller 36 and drive roller 40, is disposed on one side of the pathway 12 and the other drive roller from each pair, drive roller 38 and drive roller 42, is disposed on the other side of the pathway 12. Each of the rollers 36-42 is positioned radially adjacent the pathway and tangentially contacts the wire 18. As is known, one or more of the drive rollers 36-42 can be radially adjustably positionable relative to the wire pathway 12.

On an upstream side of the driver rollers 36-42, the support guide 14 receives the wire 18 from the roll 22 and directs the wire 18 into a bite defined between the first set of drive rollers 36,38. On a downstream side of the drive rollers 36-42, the support guide 16 receives the wire 18 from the second set of drive rollers 42,44 and directs the wire 18 into the conduit 24. A third support guide (not shown) can be provided between the sets of drive rollers 36,38 and 40,42 to guide the wire 18 from the first set of drive rollers 36,38 into the second set of drive rollers 40,42. The tubular support guides optionally include tapered interior surfaces to further facilitate guiding of the wire 18.

The first set of drive rollers 36,38 are carried on roller supports 44,46 for rotation therewith. The roller supports 44,46 are rotatably mounted in the housing 30 about respective roller support axes transverse to the wire pathway 12. The drive rollers 36,38 have respective drive roller axes coaxial with the respective roller support axes. Likewise, the second set of drive rollers 40,42 are carried on roller supports 48,50 for rotation therewith. The roller supports 48,50 are rotatably mounted in the housing 30 about respective axes transverse to the wire pathway spaced apart from the first set of drive rollers 36,38. The drive rollers 40,42 have respective drive roller axes coaxial with the respective roller support axes. The roller supports 44-50 are driveably engaged to one another. Thus, powered rotation of the roller supports 46,50 by a motor M causes rotation of the other roller supports 44,48.

With additional reference to Figure 2, each of the drive rollers 36-42 (only drive rollers 36,38 shown in Figure 2) includes a hub 52 having an outer surface 54 extending circumferentially about the corresponding drive roller axis and a plating or coating 56 on the outer surface 54 extending circumferential about the outer surface 54 and the corresponding drive roller axis. In the preferred embodiment, the plating or coating 56 is a chrome plating including a chrome alloy having between about 96% and about 97% chromium. Further, in the preferred embodiment, the chrome plating has a radial thickness of about 0.0004 includes to about 0.0006 inches and a hardness of about 70 to about 72 Rockwell C. Alternatively, the plating or coating 56 is a nickel coating having a

radial thickness of about 0.0001 inches to about 0.0030 inches and a hardness of about 60 Rockwell C. As used herein, "plating" and "coating" are used interchangeably. Thus, plating can refer to chrome, nickel or other plating and, likewise, coating can refer to chrome, nickel or another coating. The plating or coating 60 increases the useful life of each of the drive rollers 36-42 by increasing the wear resistance of the drive rollers and increasing the period of time in which the drive rollers can be used before the surfaces of the drive rollers degrade.

To impart an advancing force or motion to the wire 18, opposing sets of the drive rollers 36,38 and 40,42 are positioned sufficiently close to one another so that the wire 18 extending along the pathway 12 is compressed between the rollers 36-42. More specifically, the plating or coating 56 on the drive rollers 36-42 tangentially and compressively contacts the wire 18. The compressive force in combination with friction between the wire 12 and the rollers 36-42 advances the continuous length of wire 18 along the wire path 12 in a generally smooth and continuous manner. Optionally, one or more of the drive rollers 36-42 can be urged toward or into the wire 18 to further impart an advancing force or motion to the wire 18 when the rollers 36-42 are rotating.

In one preferred embodiment, the drive rollers 36-42 include V-shaped grooves 58 defined by angled sidewalls 60,62. The grooves extend circumferentially about the drive rollers 36-42 and serve to reduce the deformation of the wire 18 caused by the compressive forces of the drive rollers 36-42. More particularly, the wire 18 is engaged by the sidewalls 60,62. As a result, the compressive forces exerted by each pair of drive rollers 36,38 and 40,42 act and deform the wire 18 at four contact locations. As a result of the four contact locations, the drive rollers 36-42 tend to deform the wire 18 to a lesser extent than those without V-shaped grooves. In Figure 2, the drive rollers 36-42 have a pair of V-shaped grooves 58. One of the V-shaped grooves 58 on each drive roller 36-42 can be used until its defining surfaces 60,62 have degraded to a sufficient extent. Then, the wire 18 can be moved to the second of the V-shaped grooves 58. Only after both V-shaped grooves are worn out might the

drive roller need to be replaced or refurbished. The use of the coating or plating 60 over the grooves 58 has the effect of eliminating or reducing the need to clean out or remove wire residue from the grooves 58, particularly when the wire 18 is aluminum. With reference to Figure 3, drive rollers 36',38' are shown in accordance with an alternate preferred embodiment of the present invention. The drive rollers 36',38' include radial grooves 58' for receiving the wire 18. The radial grooves 58' are defined in an outer surface 54' of each of the drive rollers 36',38' and a coating or plating 56' is provided on the outer surface 54.

To apply a chrome plating to one of the drive rollers for purposes of imparting wear resistance to the drive roller, a conventional chrome plating process is utilized. Specifically, the outer surface 54 is first liquid honed to prepare the outer surface 54 for chrome alloy plating. Next, the outer surface 54 is electrolyzed to apply the chrome alloy plating thereto. When nickel is used on the outer surface, the application process is conventional and the coating requirements are designated by ATM B656 ("Standard Guide for Autocatalytic Nickel-Phosphorus Deposition of Metals for Engineering Use") and ASTM B733 ("Standard Specification for Autocatalytic Nickel-Phosphorus Coatings on Metals for Engineering Use").

The invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding description. It is intended that the invention be construed as including all such modifications and alterations insofar as they are within the scope of the appended claims or the equivalents thereof.